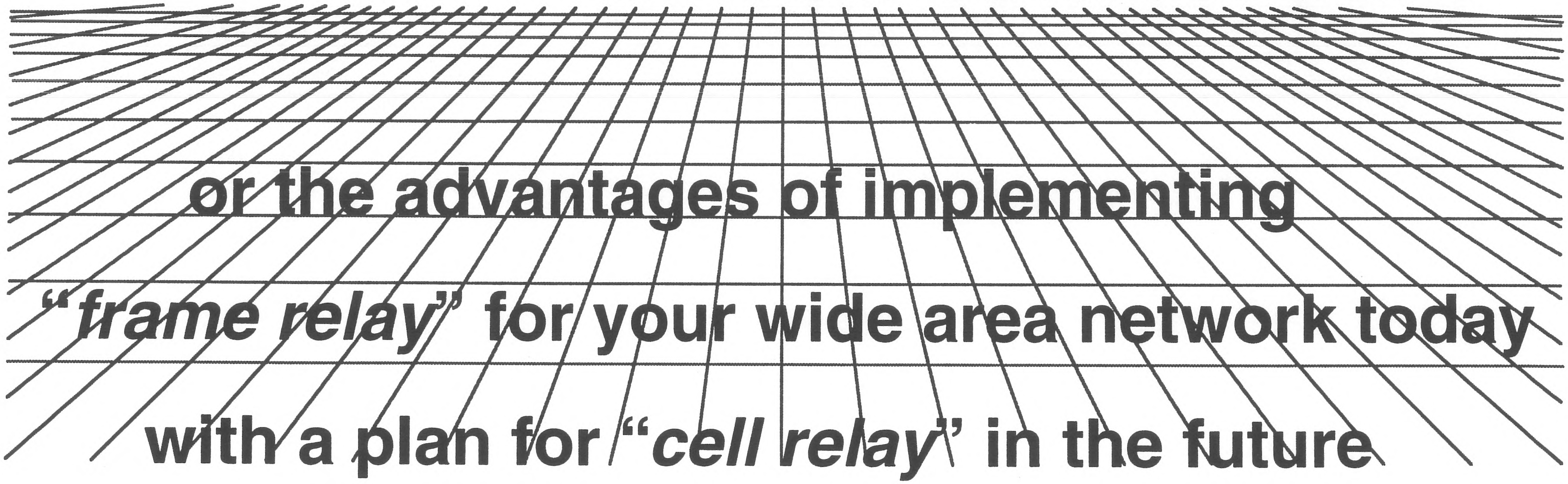
digital™

“Frame now ...

... cell tomorrow !”



or the advantages of implementing

“*frame relay*” for your wide area network today

with a plan for “*cell relay*” in the future

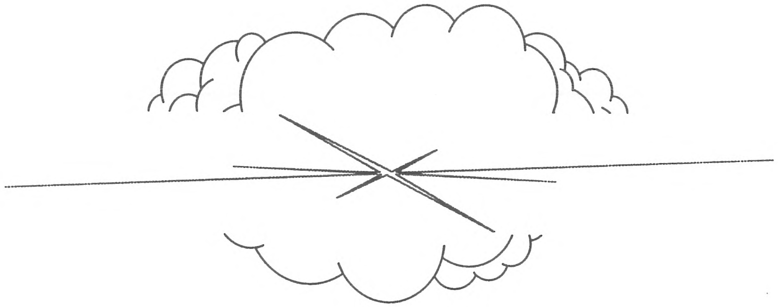
Agenda

- *What is frame relay?*
- Why to implement frame relay?
- What's next?
- How to go about it?

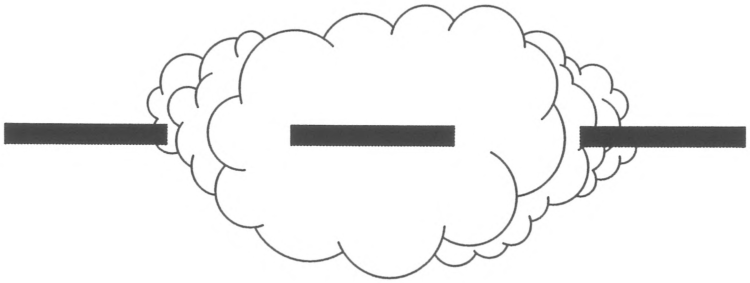
Wide area networks

- **Leased lines**
  - *Rigid*
  - *Expensive*

- **Circuit-switched**
  - *Flexible*
  - *Lower speeds*
  - *Charge for time*



- **Packet-switched**
  - *Flexible*
  - *Charge for usage*



Packet-switched networks

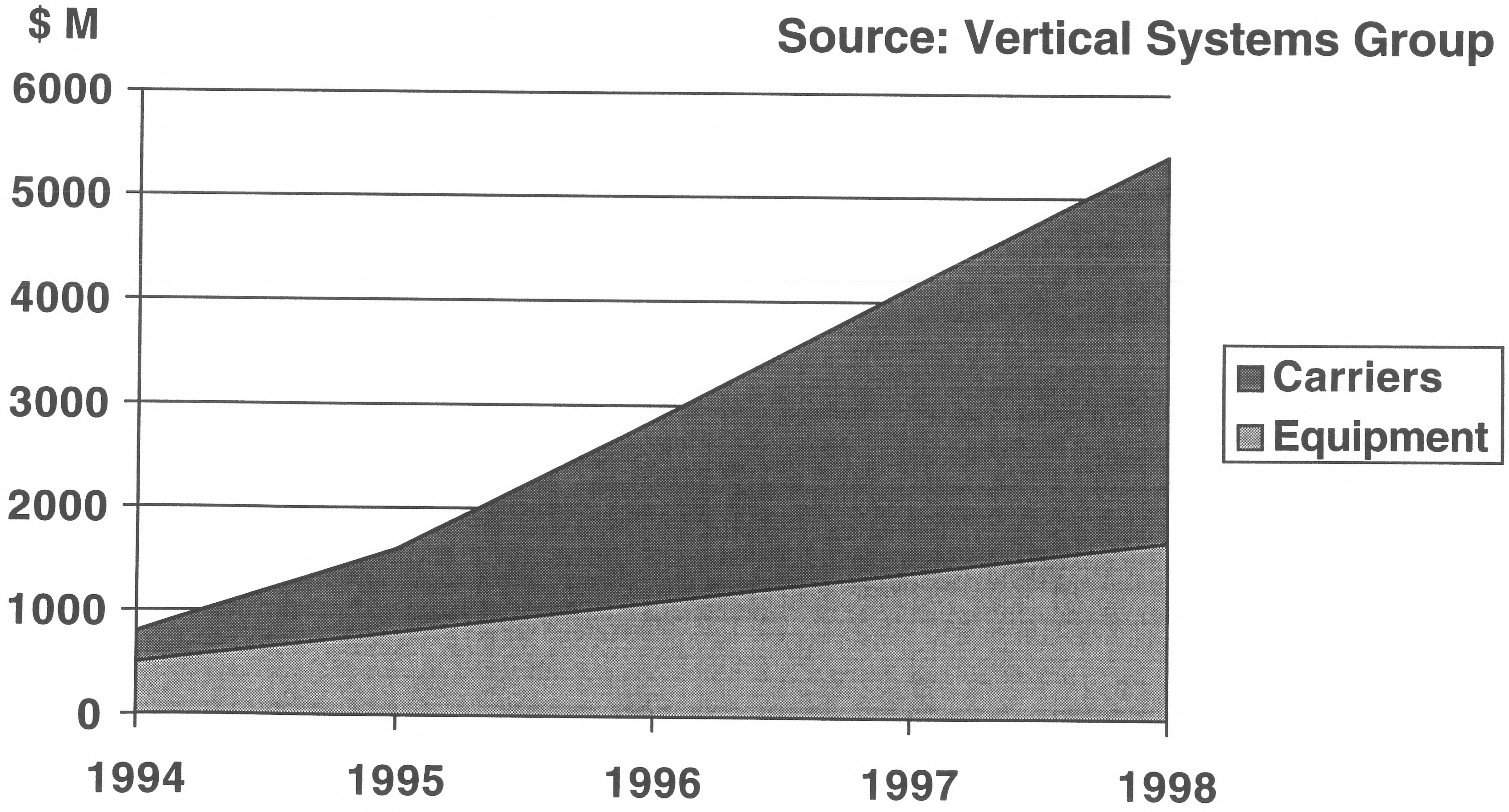
- X.25 interface networks
  - *A 1970s technology*
  - *Widely implemented*
- Frame-relay networks
  - *A 1990s technology*
  - *Widely improved over X.25*
- Cell-relay networks
  - *A 2000s technology*
  - *Small fixed frames: the great unifier*

Frame-relay networks - today !

- High transmission speeds
- Bandwidth on demand
- Low latency
- Multiprotocol support
- Flexible connectivity
- Back-up routing
- Cost effective

FR widely implemented, worldwide

Source: Vertical Systems Group



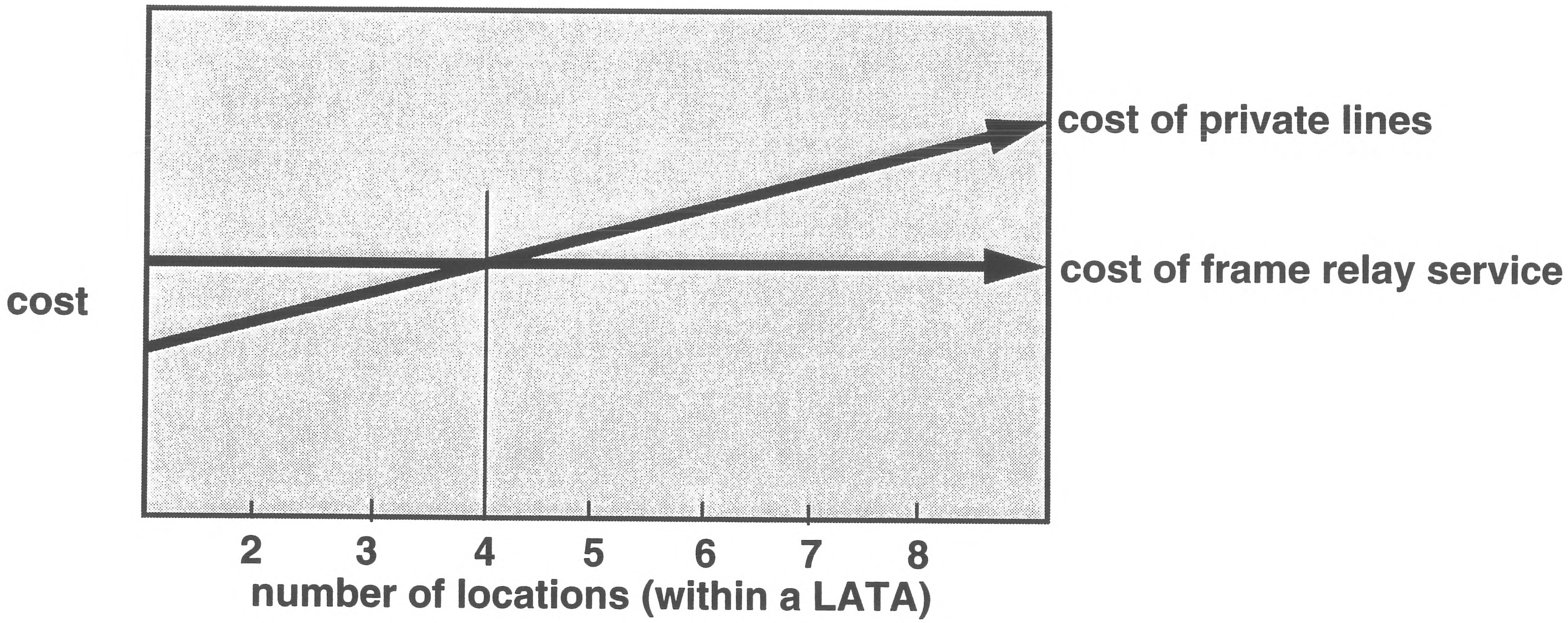
frame now!

Agenda

- What is frame relay?
- *Why to implement frame relay?*
- What's next?
- How to go about it?

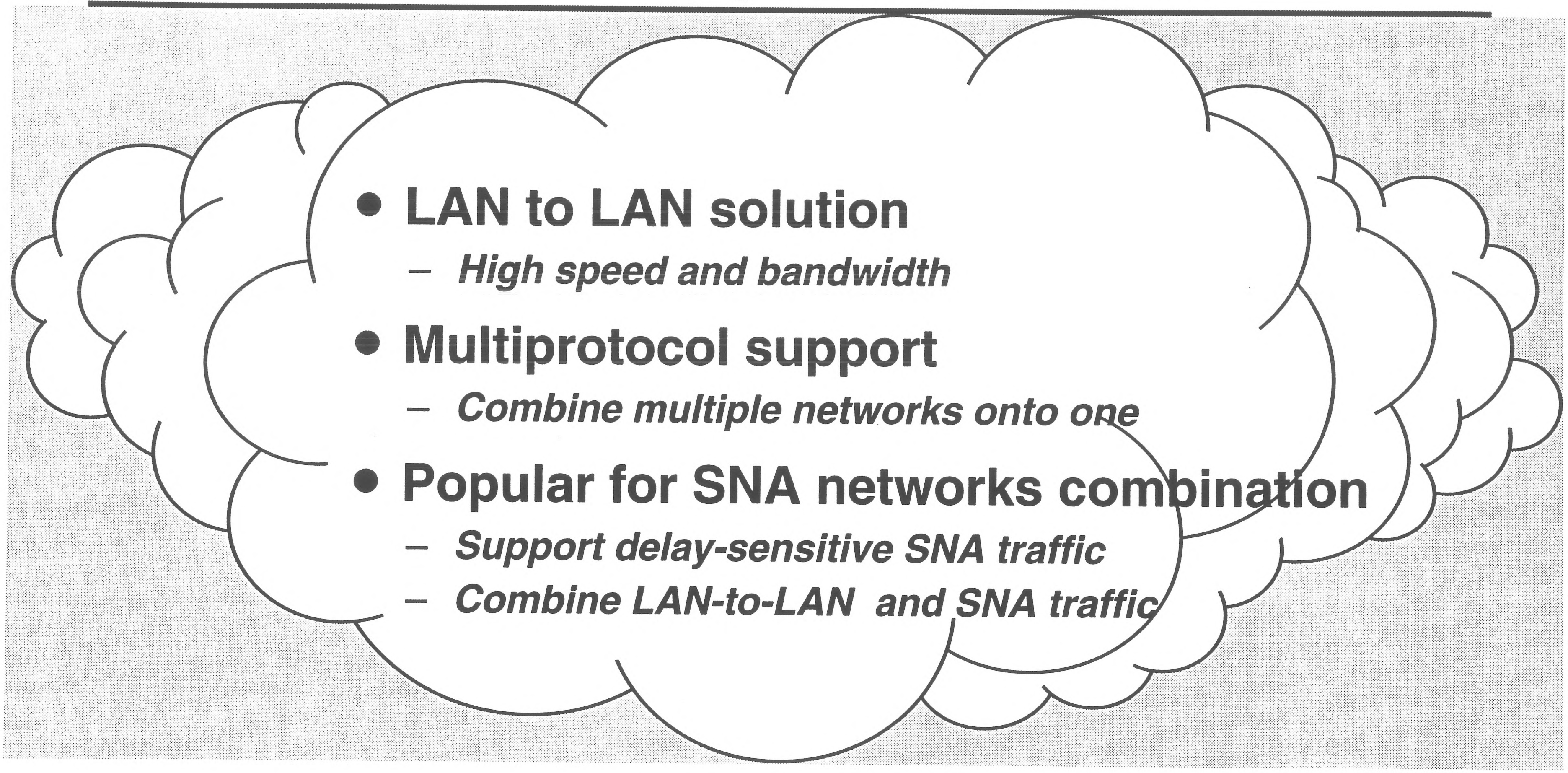
Cost justified cross-over point

On average, frame-relay costs are 25% lower than leased-lines, can reached 40%



10-15 miles between locations

Simplify the enterprise network

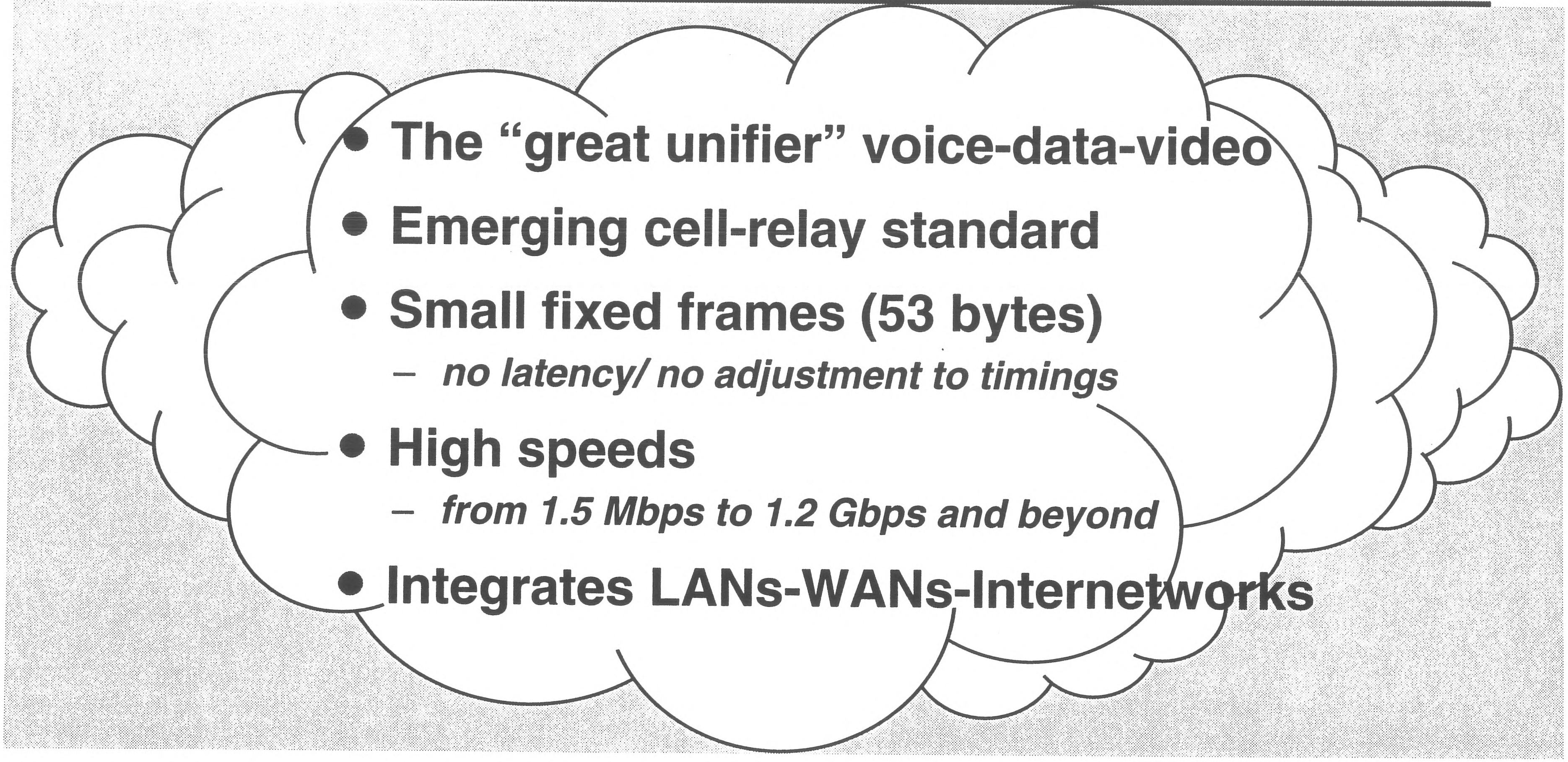


- **LAN to LAN solution**
  - *High speed and bandwidth*
- **Multiprotocol support**
  - *Combine multiple networks onto one*
- **Popular for SNA networks combination**
  - *Support delay-sensitive SNA traffic*
  - *Combine LAN-to-LAN and SNA traffic*

Agenda

- What is frame relay?
- Why to implement frame relay?
- *What's next?*
- How to go about it?

Asynchronous transfer mode (ATM)



- The “great unifier” voice-data-video
- Emerging cell-relay standard
- Small fixed frames (53 bytes)
  - *no latency/ no adjustment to timings*
- High speeds
  - *from 1.5 Mbps to 1.2 Gbps and beyond*
- Integrates LANs-WANs-Internetworks

From FR to ATM

- The "*Frame Relay Forum*" (Digital as a founding member) and the "*ATM Forum*" are working together to set interoperability standards

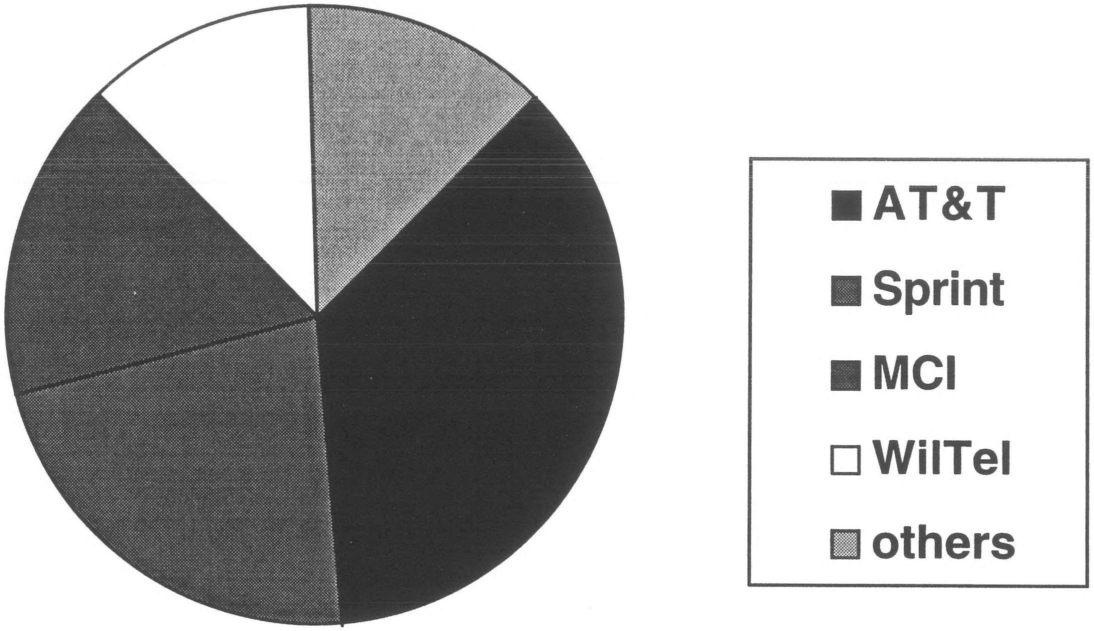
- It is important that your design for frame relay incorporates strategy for evolution towards ATM

Agenda

- **What is frame relay?**
- **Why to implement frame relay?**
- **What's next?**
- ➡ ***How to go about it?***

Competitive carrier offerings

Numerous offerings, different tariffs, interoperability issues

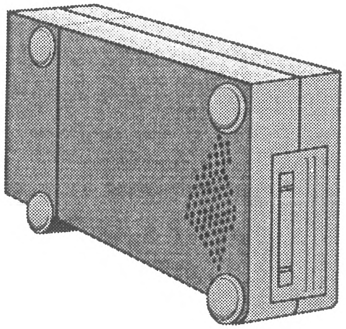


The carrier selection can be difficult

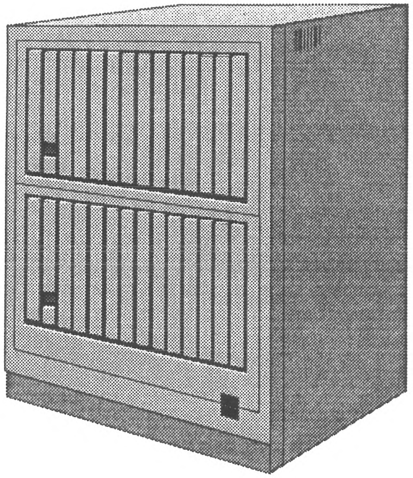
Frame relay: the global view

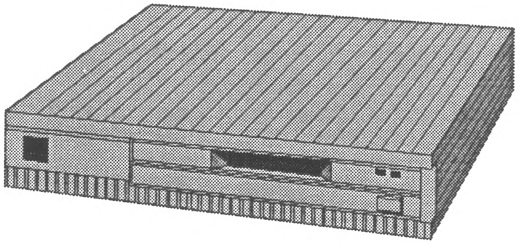
	Australia	AustrIa	Belgium	Canada	Denmark	Finland	France	Germany	Hong Kong	Ireland	Italy	Japan	Korea	Luxembourg	Mexico	Netherlands	Norway	Russia	Singapore	Spain	Sweden	Switzerland	Taiwan	UK	USA
AT&T		▨	▨	▨	▨	▨	▨	▨		▨	▨	▨		▨		▨	▨		▨	▨	▨	▨		▨	▨
BT	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨	▨		▨	▨	▨	▨		▨	▨
Cable & Wireless	▨						▨	▨	▨	▨	▨	▨				▨		▨		▨	▨	▨		▨	▨
Compuserve		▨	▨	▨	▨		▨	▨		▨	▨					▨				▨	▨	▨		▨	▨
Deutsche Telekom						▨		▨				▨												▨	
Eunetcom			▨			▨	▨				▨					▨			▨	▨	▨			▨	▨
France Telecom		▨	▨		▨	▨	▨	▨		▨	▨					▨	▨			▨	▨	▨		▨	
Infonet	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨		▨	▨	▨	▨	▨	▨	▨
KDD												▨							▨				▨		▨
MCI	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨	▨		▨	▨	▨	▨		▨	▨
MFS							▨	▨																▨	▨
Singapore Telecom												▨							▨						▨
SITA	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Sprint	▨	▨	▨	▨		▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨			▨		▨		▨	▨
Telecom Finland			▨			▨		▨								▨		▨			▨			▨	
Tele Media		▨	▨	▨				▨			▨					▨				▨	▨	▨		▨	▨
Telstra	▨																								
Unisource		▨	▨		▨	▨	▨	▨		▨	▨					▨	▨			▨	▨	▨		▨	▨
Wiltel				▨			▨	▨			▨													▨	▨

Customer premises equipment (CPE)



- Bridges
- Routers
- FRADs





→ *The equipment selection can be difficult*

Design for today, and the future

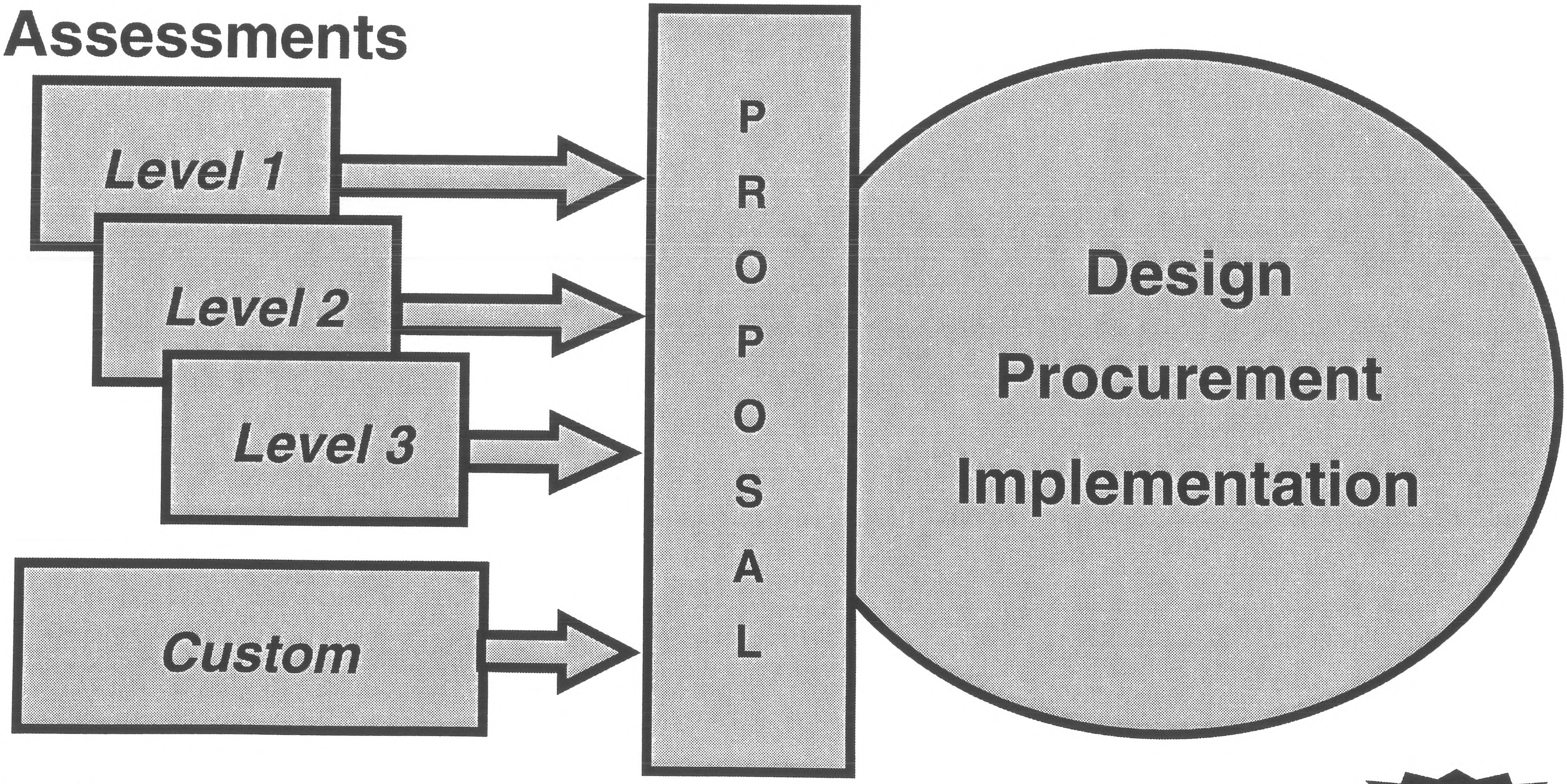
When implementing frame relay

- Today's design need to incorporate strategy for evolving towards cell relay and ATM tomorrow
- There are numerous carrier services to select from, and customer premises equipment to evaluate, implement and manage
- A network services provider with proven track-record can be the ideal partner to succeed in such an adventure

→ ***Consider Digital Multivendor Network Services***

digital™

Fast turn out with predefined assessments



Assessments

Level 1

Level 2

Level 3

Custom

PROPOSAL

Design

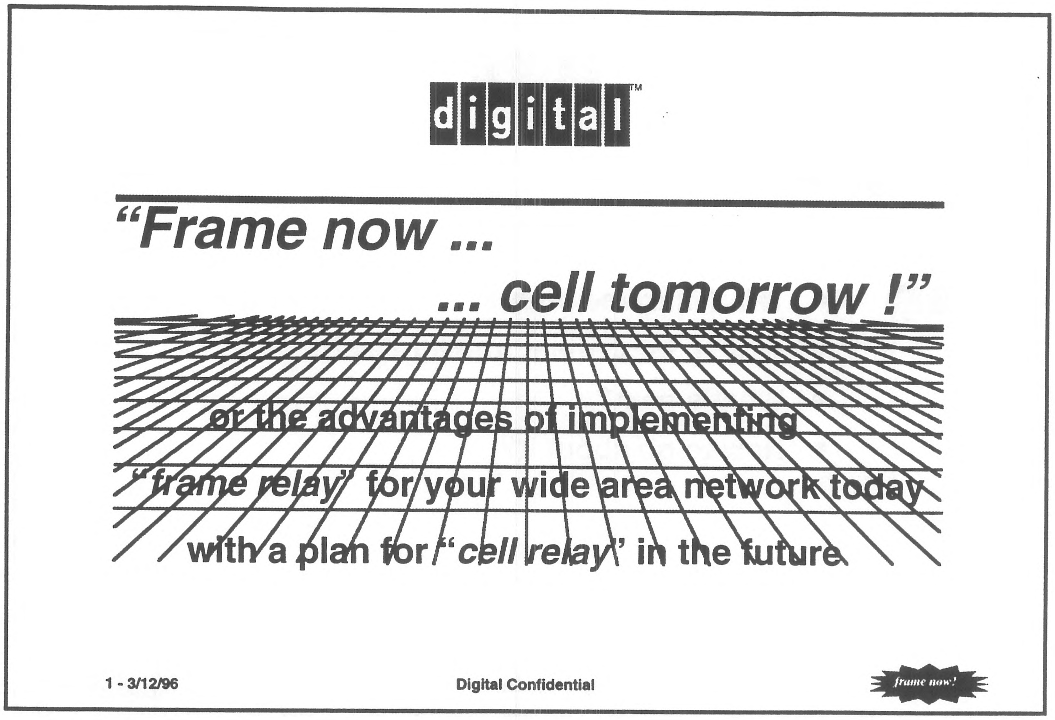
Procurement

Implementation

frame now!

digital™

Digital Equipment Corporation
© 1996



digital™

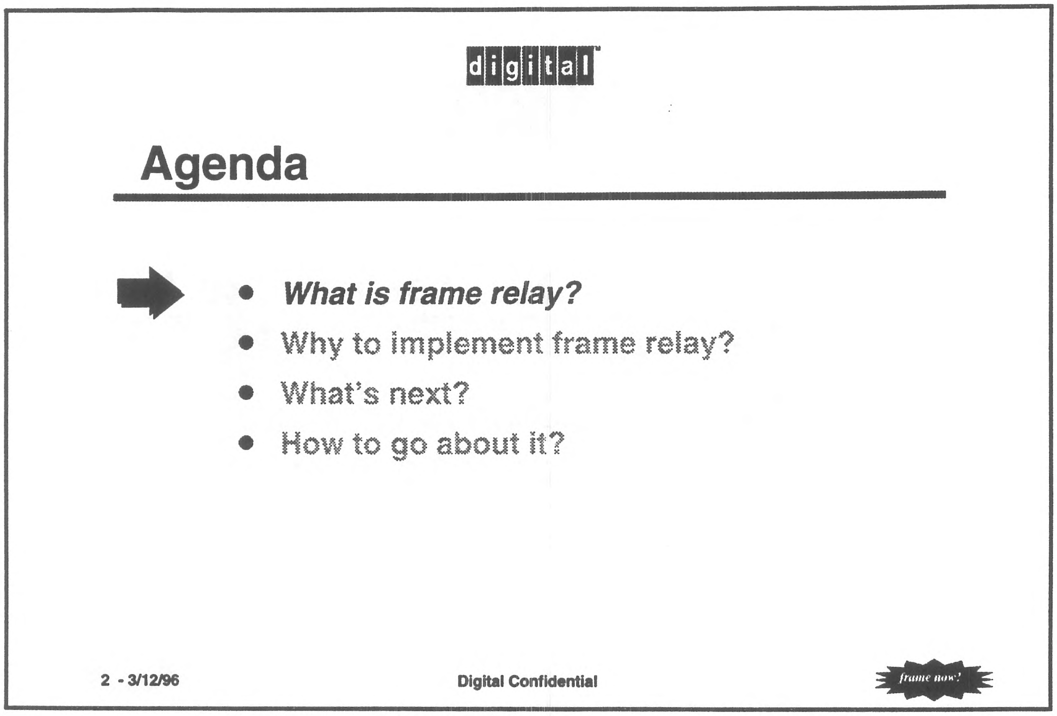
"Frame now ...
... cell tomorrow !"

or the advantages of implementing *"frame relay"* for your wide area network today with a plan for *"cell relay"* in the future

1 - 3/12/96 Digital Confidential

This presentation is an overview of the widely successful frame-relay technology and services available today for wide area networks. It presents the advantages of implementing frame relay today in order to reap its benefits. However, the communications and networking world is quickly changing. Cell-relay technologies are emerging and are guaranteed to become the solution of choice ... someday.

Therefore, it is important while implementing frame relay today, to plan for cell relay in the future, and build this forward thinking in the initial design of your network.



digital

Agenda

- ***What is frame relay?***
- Why to implement frame relay?
- What's next?
- How to go about it?

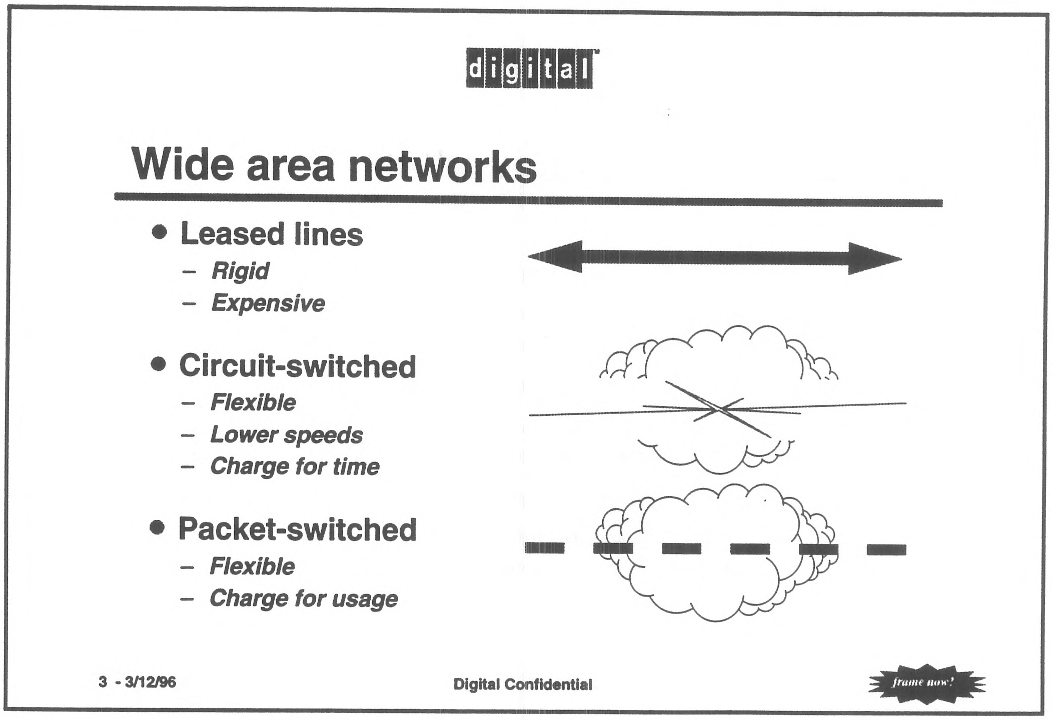
2 - 3/12/96

Digital Confidential

frame now!

We will review:

- the frame-relay networking technology,
- its advantages that call for its rapid implementation,
- the emerging cell-relay technologies with ATM,
- and how to go about implemeting a successful frame-relay network that will easily evolve towards ATM (cell relay) in the future.



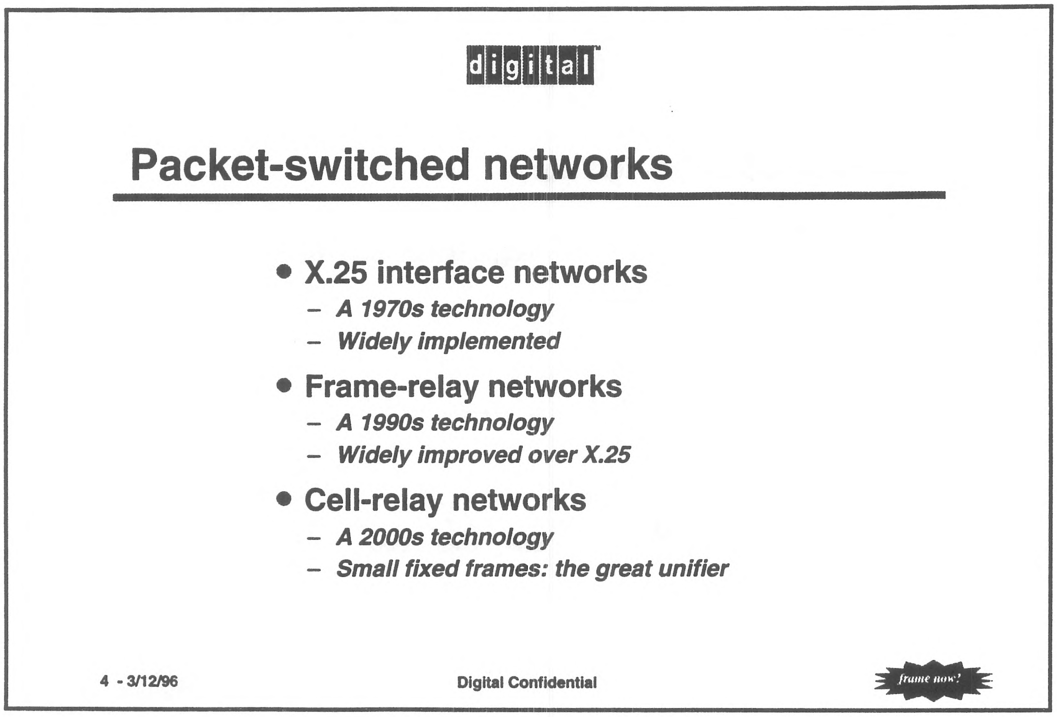
Wide area networks

- **Leased lines**
  - *Rigid*
  - *Expensive*
- **Circuit-switched**
  - *Flexible*
  - *Lower speeds*
  - *Charge for time*
- **Packet-switched**
  - *Flexible*
  - *Charge for usage*

3 - 3/12/96

Digital Confidential

- Leased lines are expensive, especially for high speed communications; they are fixed and therefore their configuration is rigid.
- Circuit-switched data services provide more flexibility, since it is possible to dial in from any location that has access to the communications carrier; however, they are limited to lower speeds of transmission (64kbps, 128 at best); on the top of a basic connection fee, users are charged for the time of connection.
- Packet-switched networks are also flexible and in most cases economical since their fees are mainly usage-based, on the top of a basic connection charge.



Packet-switched networks

- **X.25 interface networks**
  - *A 1970s technology*
  - *Widely implemented*
- **Frame-relay networks**
  - *A 1990s technology*
  - *Widely improved over X.25*
- **Cell-relay networks**
  - *A 2000s technology*
  - *Small fixed frames: the great unifier*

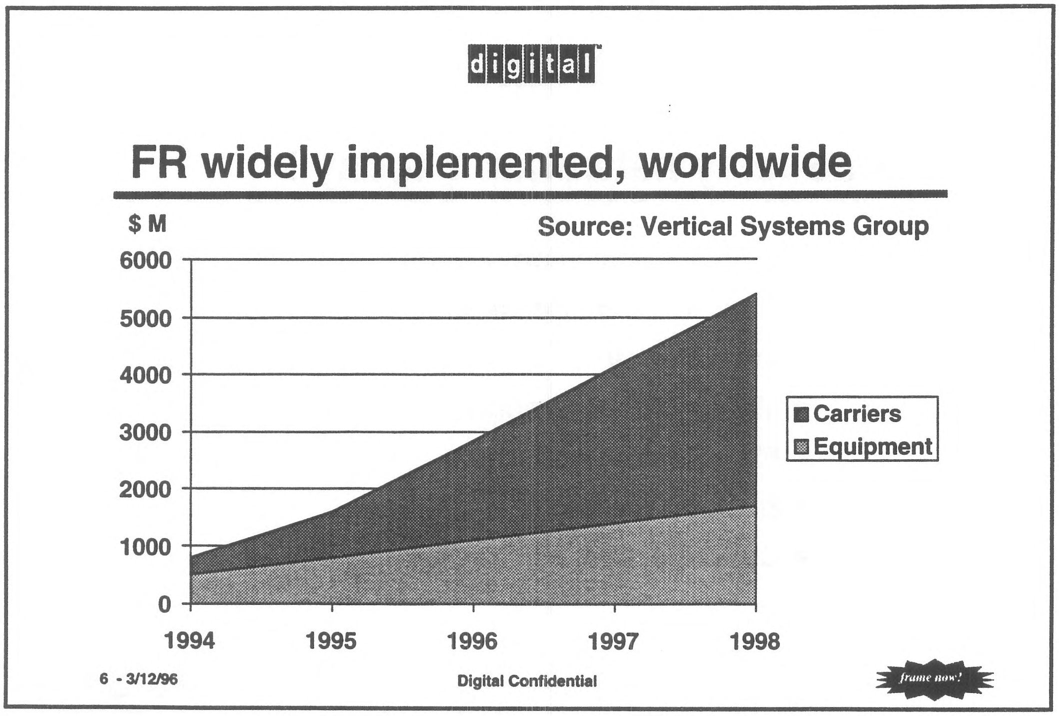
4 - 3/12/96 Digital Confidential

- X.25 networks are widely implemented worldwide, but are using outdated technology of the 1970s when long distance communications lines were unreliable; these networks are using complex protocols resulting in low speeds (up to 64kbps) and high latency: they carry a single type of protocol.
- Frame relay, in a nutshell is the X.25 for the 1990s; it takes into account that most long haul networks are digital, using fiber optics carriers, and much more reliable; the protocols have been streamlined for higher efficiency, greater speeds of transmission (56kbps to T1/ 1.544Mbps are the rule today - a T3/ 45Mbps specification is underway), and lower latency that makes them appropriate to support SNA networks that are delay-sensitive.
- Cell relay with ATM (Asynchronous Transfer Mode) as the emerging standard, uses small fixed-size frames or cells; it will become the “great unifier” able to carry voice/ data/ video over the same network integrating LANs and WANs; there are numerous isolated implementations with speeds higher by orders of magnitude (1.2Gbps demonstrated), but there are still a lot of issues to be resolved and standards to be agreed upon before it can become an universal industry-proof mode of communications; it will become the standard of the next decade.

Frame-relay networks - today !

- High transmission speeds
- Bandwidth on demand
- Low latency
- Multiprotocol support
- Flexible connectivity
- Back-up routing
- Cost effective

- Typical speeds: from 56kbps to T1/ 1.544Mbps and E1/2.048Mbps - E3/ 34Mpbs and T3/45Mbps specifications are underway and could be implemented by the end of 1996
- By setting the CIR (committed information rate) at one-half the port speed on the frame-relay switch, users can have their data burst up to the full speed of the port - at no extra charge.
- The low latency makes frame relay ideally suited to deal with SNA traffic that is delay-sensitive
- Thanks to the multiprocol support, it is possible to carry diverse types of traffic over the same network, therefore making possible to consolidate multiple networks onto one.
- With flexible connectivity, configurations are easy to set up and to modify; the network is often represented as an anamorphous cloud manged by the telephone company.
- Frame-relay networks are using virtual circuits can provide back-up routing; if a link comes to fail, the network will establish another route, transparently to the communicating endpoints.
- And since users are mainly charged for the amount of traffic transmitted, frame relay is the most economical mode of communications, especially for interactive bursty traffic.



FR widely implemented, worldwide

Source: Vertical Systems Group

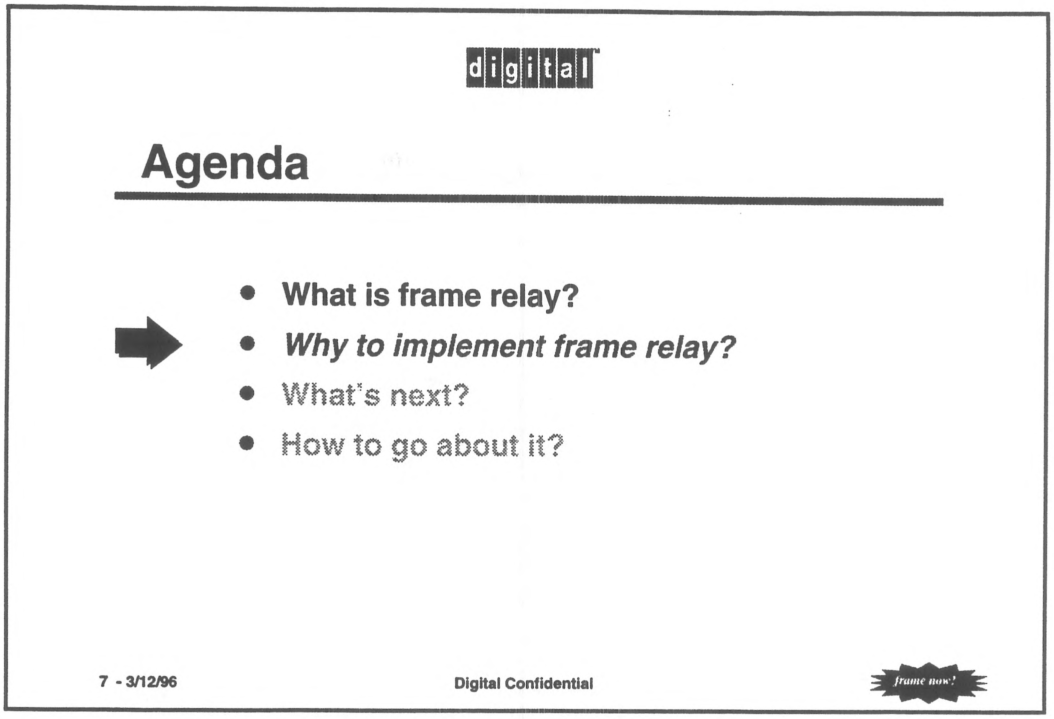
6 - 3/12/96

Digital Confidential

The worldwide market for frame-relay carrier services and for equipment is exploding; here follow estimates from Vertical Systems Group, a market research organization from Dedham, MA:

- 1994: $ 793M
- 1995: $ 1,662M
- 1996: $ 2,844M
- 1997: $ 4,147M
- 1998: $ 5,382M

In 1996, about two-third of the revenues will be generated in the USA .



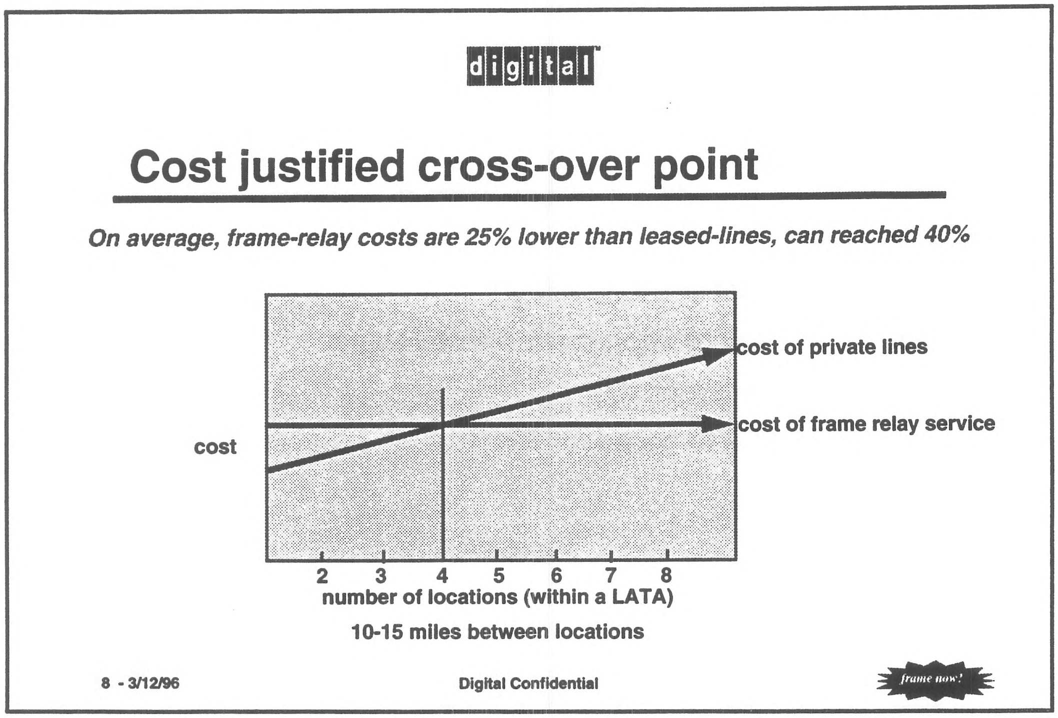
digital

Agenda

- What is frame relay?
- ➡ *Why to implement frame relay?*
- What's next?
- How to go about it?

7 - 3/12/96 Digital Confidential frame now!

Review of the benefits of frame relay to your organization.



Cost justified cross-over point

On average, frame-relay costs are 25% lower than leased-lines, can reached 40%

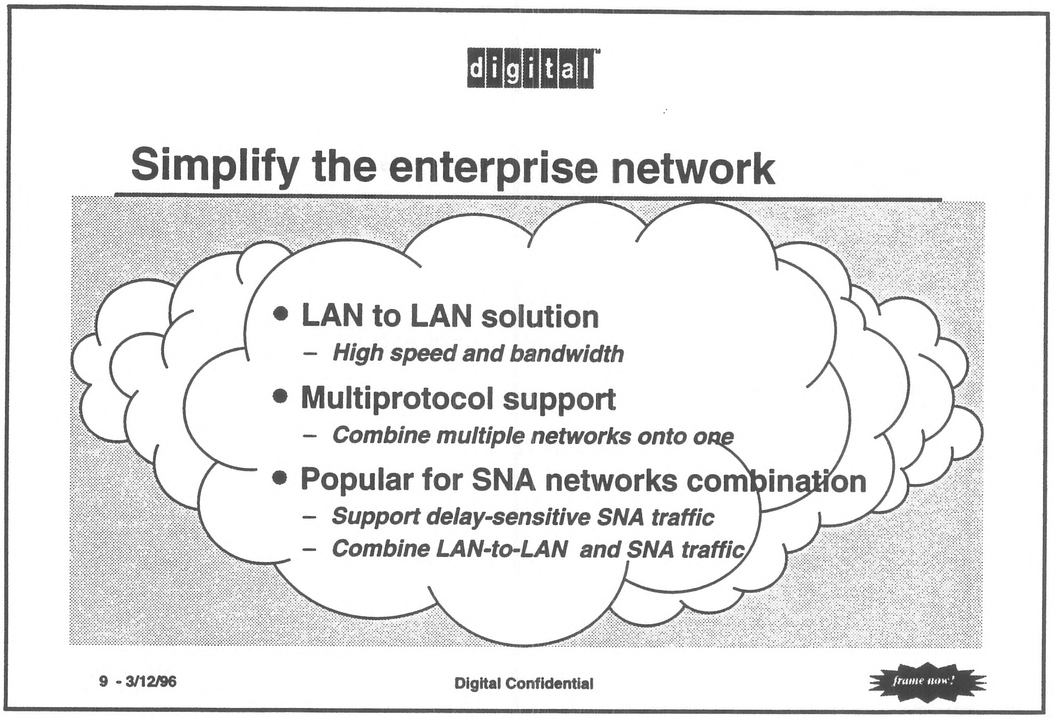
8 - 3/12/96

Digital Confidential

If your network has multiple locations within a LATA (local access transport area) and a 10 to 15 miles distance between sites, you are an excellent candidate for frame relay, and save up to 40% on your communications costs when compared to a leased lines-based private network!

Cost savings related to implement a frame relay strategy strategy include:

- Predictable flat rate monthly charges,
- Lower local loop charges through shared access,
- Increased connectivity and expansion
- Changes or added connections are easy and inexpensive.



Simplify the enterprise network

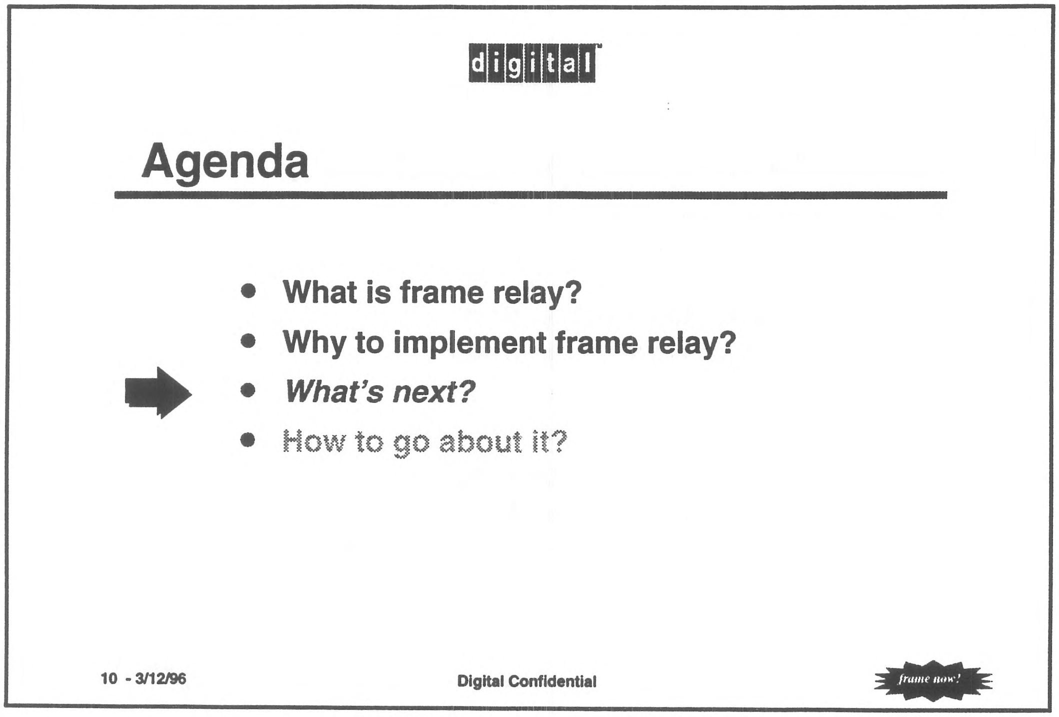
- **LAN to LAN solution**
  - *High speed and bandwidth*
- **Multiprotocol support**
  - *Combine multiple networks onto one*
- **Popular for SNA networks combination**
  - *Support delay-sensitive SNA traffic*
  - *Combine LAN-to-LAN and SNA traffic*

9 - 3/12/96

Digital Confidential

frame now!

- Frame relay is a good solution to internetwork remote LANs due to the high speed of transmission.
- Thanks to its support of mutiple protocols, various networks can be combined into one frame-relay network,for considerable savings.
- Due to its low latency, frame relay is a good solution to carry SNA delay-sensitive traffic, and since it supports multiple protocols, the same frame-relay network can transport SNA communications, TCP/IP, IPX/SPX, ... It is becoming a popular solution and 1,800 SNA networks will convert to frame-relay in the USA alone in 1996 (Vertical Systems Group).



digital

Agenda

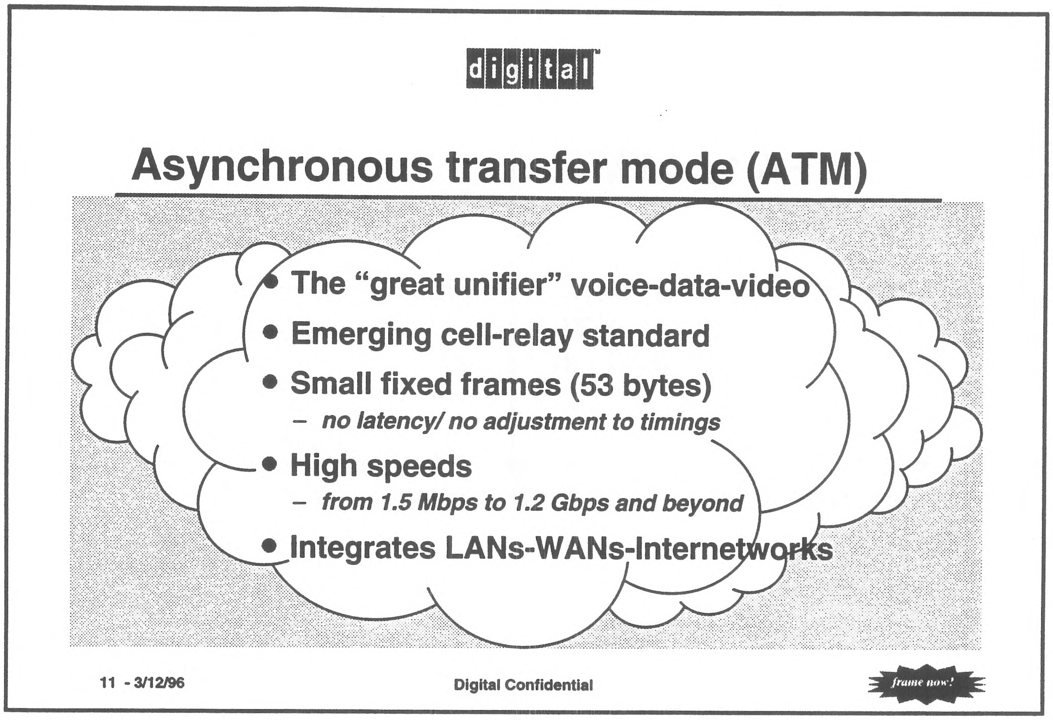
- **What is frame relay?**
- **Why to implement frame relay?**
- ➡ ***What's next?***
- How to go about it?

10 - 3/12/96

Digital Confidential

frame now!

The communications and networking world is rapidly changing, and while implementing a new technology, it is important to consider what the next technology will be in order to protect investments. We will review cell relay that will be the successor of frame relay.



Asynchronous transfer mode (ATM)

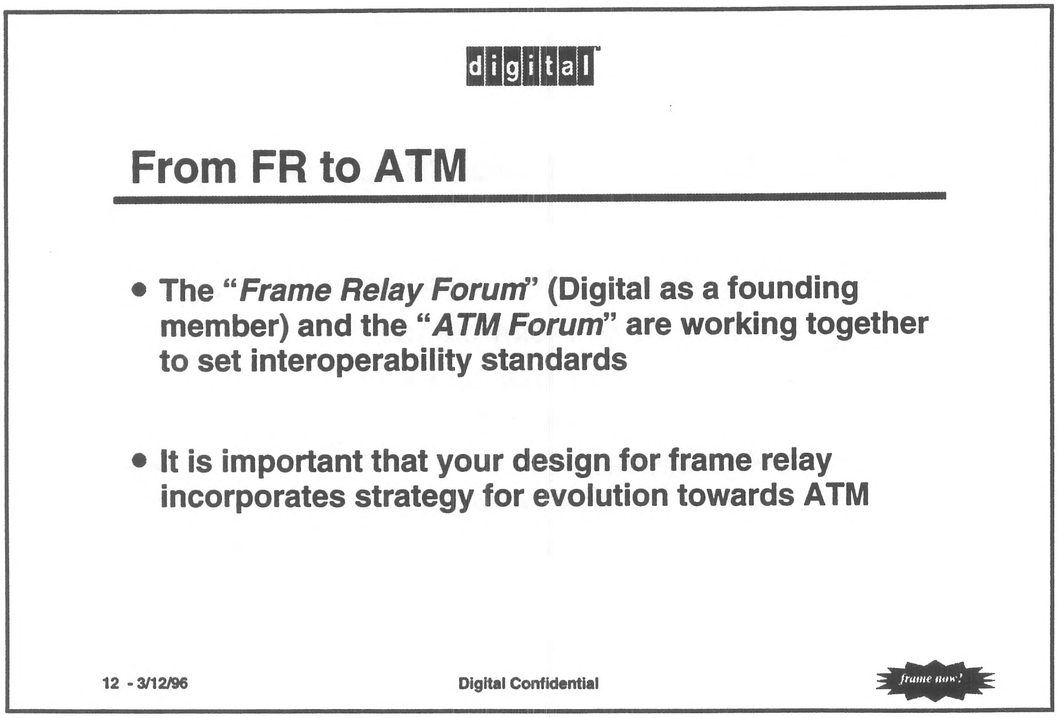
- The “great unifier” voice-data-video
- Emerging cell-relay standard
- Small fixed frames (53 bytes)
  - *no latency/ no adjustment to timings*
- High speeds
  - *from 1.5 Mbps to 1.2 Gbps and beyond*
- Integrates LANs-WANs-Internetworks

11 - 3/12/96

Digital Confidential

frame now!

- ATM (asynchronous transfer mode) will be the “*great unifier*” of the communications world, able to transport voice, data and video on the same carriers.
- ATM is becoming the standard for cell-relay communications.
- The first characteristic of cell relay is that it carries small fixed frames of 53 bytes each (48 bytes for information + 5 bytes for header): the cell. Therefore switching cells can very fast with no latency and no timings adjustment for flow control when compared to frame relay that has to deal with frames of variable size.
- As a result, transmission speeds can be very high and reach the order of Giga bit per second.
- These speeds make the distinction between local area networks and wide area networks blurred; another reason why ATM is becoming the “*great unifier*”.

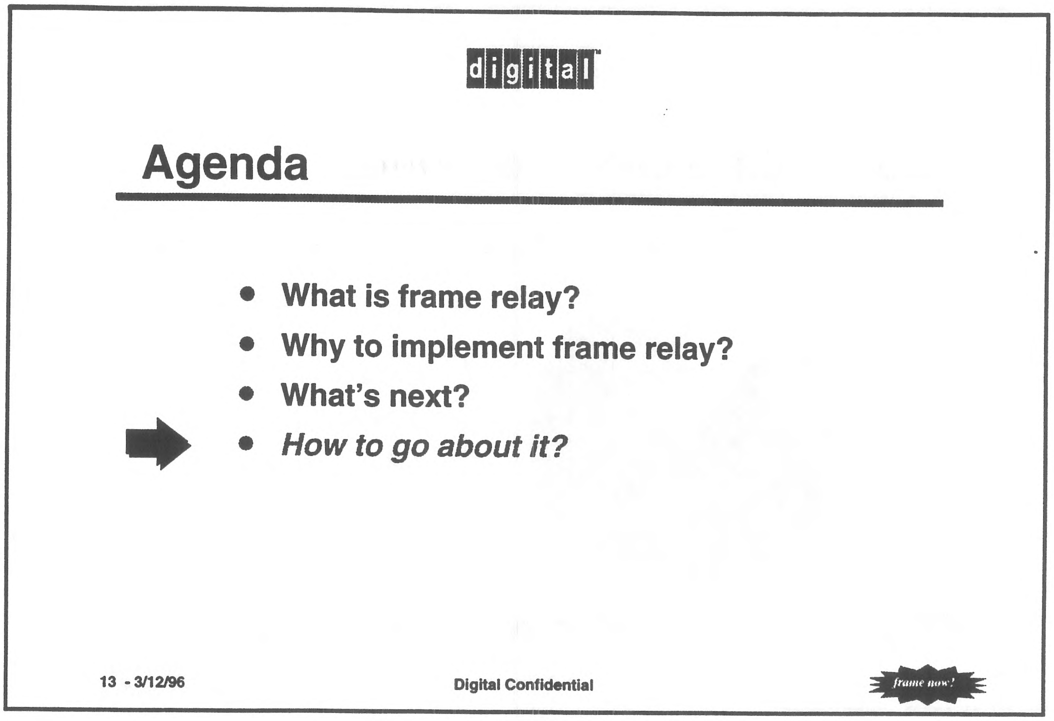


From FR to ATM

- The "*Frame Relay Forum*" (Digital as a founding member) and the "*ATM Forum*" are working together to set interoperability standards
- It is important that your design for frame relay incorporates strategy for evolution towards ATM

12 - 3/12/96 Digital Confidential

- Digital Equipment Corporation with Cisco, Northern Telecom and Stratacom was a founding member of Frame Relay Forum. Since 1990, the "gang of four" has grown to 300 members worldwide that collaborate on frame-relay specifications. The ATM Forum is a similar consortium of users and vendors working on ATM specifications. Both Forums now cooperate to develop interoperability standards between frame-relay and cell-relay networks in order to ensure coexistence and to provide smooth evolution from one to the next, protecting users investments.
- When designing a frame-relay network, it important to build in the strategy for incorporating ATM in the future.



digital

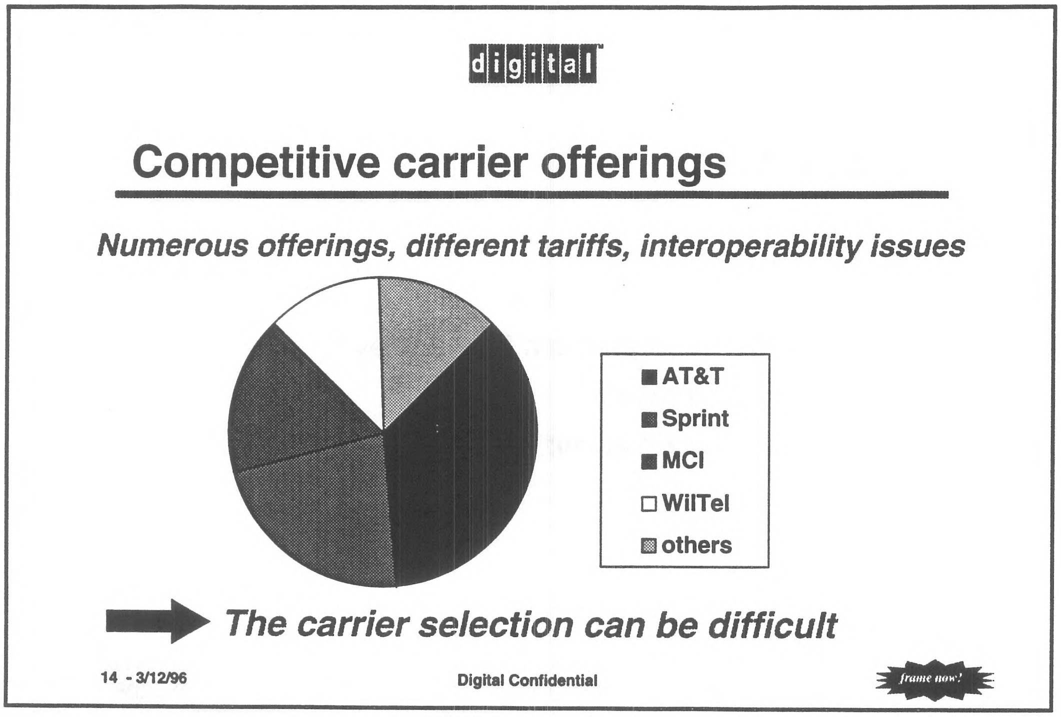
Agenda

- What is frame relay?
- Why to implement frame relay?
- What's next?
- ➡ *How to go about it?*

13 - 3/12/96

Digital Confidential

Now that frame relay appears to be the right choice for your organization, how to implement it?


■ AT&T
▨ Sprint
■ MCI
□ WilTel
▨ others

Competitive carrier offerings

Numerous offerings, different tariffs, interoperability issues

➡ ***The carrier selection can be difficult***

14 - 3/12/96

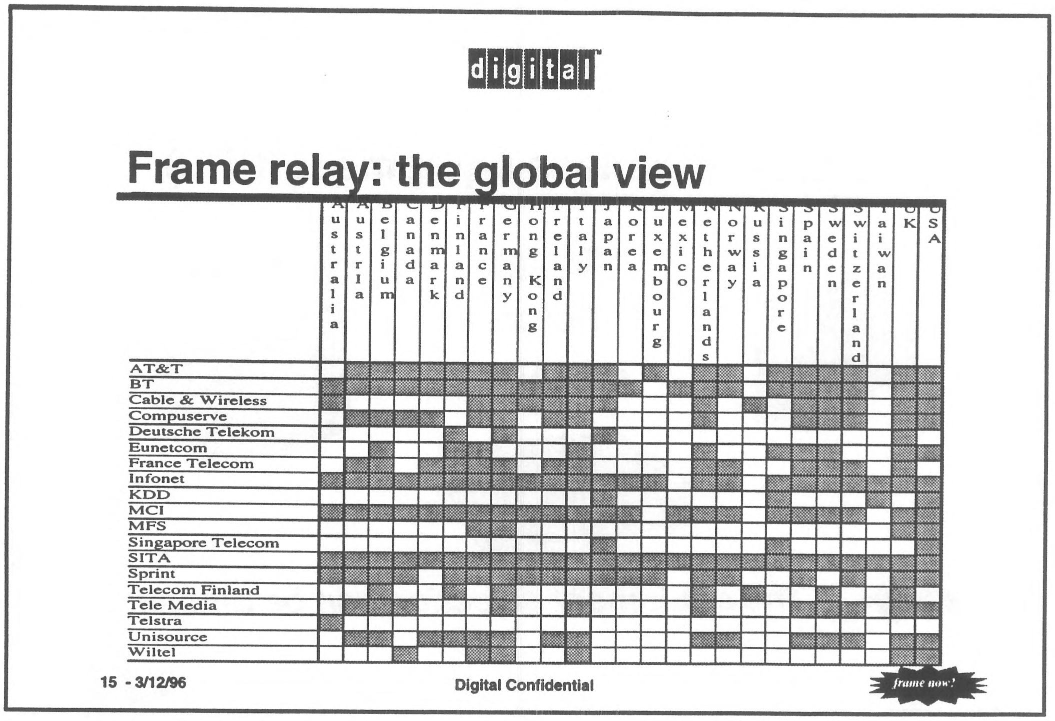
Digital Confidential

frame now!

The huge success of frame relay attracts numerous players; for example in the USA, all the major interexchange carriers have a controlling share of the market, but the local carriers and RBOCs are now entering it:

- AT&T InterSpan	36%
- Sprint Frame-Relay	22%
- MCI HyperStream	17%
- WilTel	12%

These competitive offerings with various tariffs create confusion. There are also interoperability issues between many carriers. This situation creates a difficult choice for the prospective user of frame relay.



Frame relay: the global view

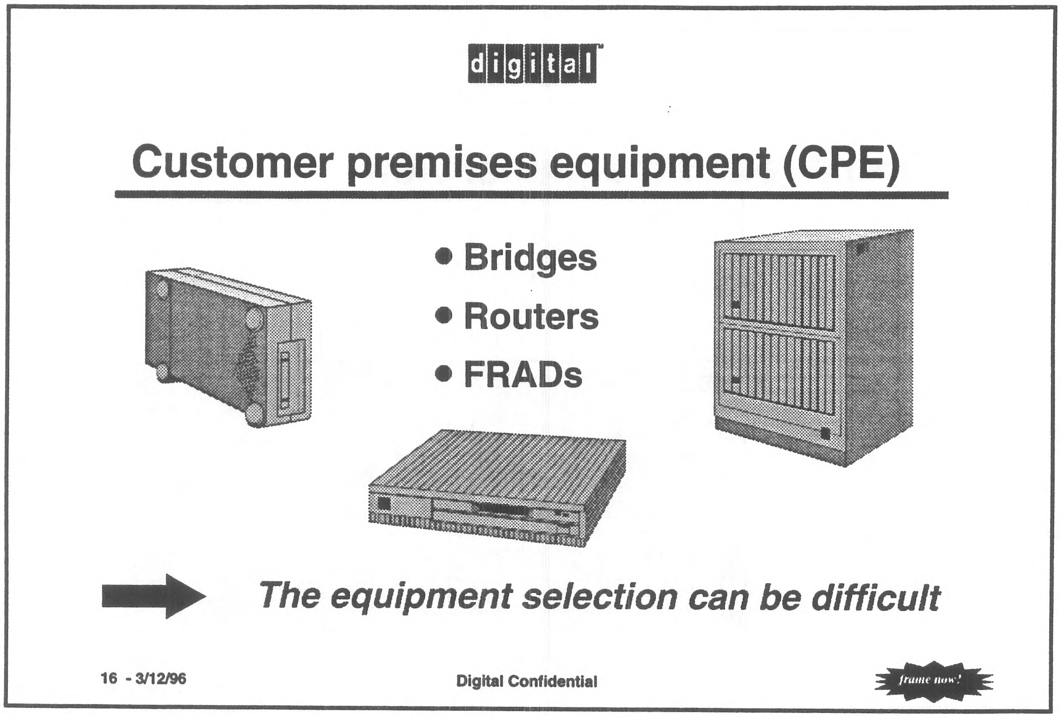
	Australia	Austria	Belgium	Canada	Denmark	Finland	France	Germany	Hong Kong	Ireland	Italy	Japan	Korea	Luxembourg	Mexico	Netherlands	Norway	Russia	Singapore	Spain	Sweden	Switzerland	Taiwan	UK	USA
AT&T		▨	▨	▨	▨	▨	▨	▨		▨	▨	▨		▨		▨	▨		▨	▨	▨	▨		▨	▨
BT	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨	▨		▨	▨	▨	▨		▨	▨
Cable & Wireless	▨						▨	▨	▨	▨	▨	▨				▨		▨	▨	▨	▨	▨		▨	▨
Compuserve		▨	▨	▨	▨		▨	▨		▨	▨					▨				▨	▨	▨		▨	▨
Deutsche Telekom						▨		▨				▨												▨	
Eunetcom			▨			▨	▨				▨					▨			▨	▨	▨			▨	▨
France Telecom		▨	▨		▨	▨	▨	▨		▨	▨					▨	▨			▨	▨	▨		▨	
Infonet	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨		▨	▨	▨	▨	▨	▨	▨
KDD												▨							▨				▨		▨
MCI	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨	▨		▨	▨	▨	▨		▨	▨
MFS							▨	▨																▨	▨
Singapore Telecom												▨							▨						▨
SITA	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Sprint	▨	▨	▨	▨		▨	▨	▨	▨	▨	▨	▨	▨	▨		▨	▨			▨		▨		▨	▨
Telecom Finland			▨			▨		▨								▨		▨			▨			▨	
Tele Media		▨	▨	▨				▨			▨					▨				▨	▨	▨		▨	▨
Telstra	▨																								
Unisource		▨	▨		▨	▨	▨	▨		▨	▨					▨	▨			▨	▨	▨		▨	▨
Wiltel				▨			▨	▨			▨													▨	▨

15 - 3/12/96

Digital Confidential

frame now!

More than twenty communications carriers and PTTs now offer international frame relay services, and many of them say orders are flooding in at a phenomenal pace. Here is an inventory of the geographic coverage of the major players.



Customer premises equipment (CPE)

- **Bridges**
- **Routers**
- **FRADs**

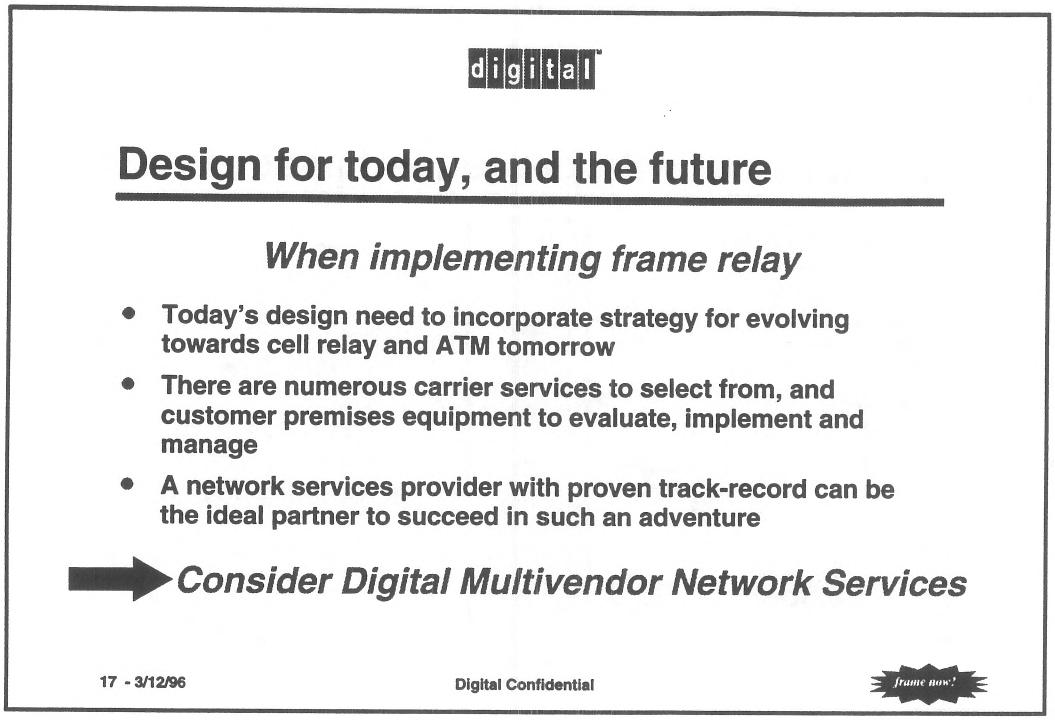
➡ ***The equipment selection can be difficult***

16 - 3/12/96

Digital Confidential

The selection of the right piece of equipment can be difficult:

- Bridges are popular for basic LAN traffic interface.
- Routers are the best choice for most LAN traffic.
- FRADs (frame-relay access devices) the most cost effective for traffic to legacy mainframes.



Design for today, and the future

When implementing frame relay

- **Today's design need to incorporate strategy for evolving towards cell relay and ATM tomorrow**
- **There are numerous carrier services to select from, and customer premises equipment to evaluate, implement and manage**
- **A network services provider with proven track-record can be the ideal partner to succeed in such an adventure**

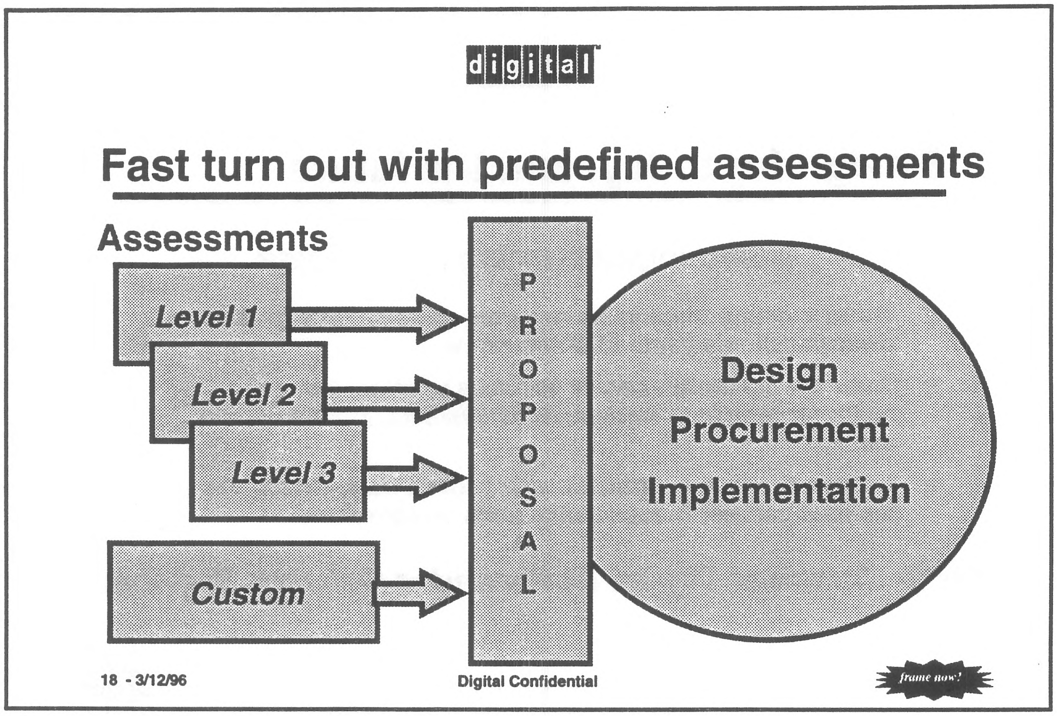
➡ ***Consider Digital Multivendor Network Services***

17 - 3/12/96

Digital Confidential

frame now!

- You can reap the benefits of frame relay today, like many users are doing. When implementing frame relay, it is important to plan for cell relay and ATM in the future, and build this forward thinking in the initial design of your network in order to protect your investments.
- There are numerous choices to be made among the various carrier services offerings, pitfalls to be avoided regarding interoperability, and more choices for the most appropriate on-premises equipmnet.
- A network services provider with a proven track record in the planning, design, implementation and management of frame relay can be a precious partner to help you make the best choices and complement the skills of your own staff.
- Digital Multivendor Network Services can be such an ideal partner to help you out, back you up, complement and train your staff, and even take over the tasks that you'd rather delegate.



Fast turn out with predefined assessments

18 - 3/12/96

Digital Confidential

frame now!

Digital Multivendor Network Services is experienced in the planning, the design, the implementation and the management of frame-relay networks. Thanks to our expertise, we have been able to pre-defined typical assessment services in order to propose you a game plan on how best implement frame relay within your own organization. Each of these assessment levels has a fixed price making it easy to select and providing fast turn around.

There are three levels, each corresponding to the degree of complexity of the network environment. A short questionnaire permits to quickly select the assessment level for a specific environment::

- Level 1: 1- 4 sites, point-to-point topology, modems, ...
- Level 2: 1-20 sites, star or hierarchical topoly, bridges/ routers, ...
- Level 3: 1-40 sites, star or mesh topology, routers, ...

If the network environment is complex and does not fall within the limits predefined, then a custom assessment needs to be appraised with the assistance of a Network Consultant.

digital™

Digital Equipment Corporation

© 1996